# Thermodynamic Properties of Superheated Liquid Xenon in the Vicinity of a Critical Point

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The p, ρ, T - properties and the isochoric heat capacity of liquid xenon have been investigated by experiment in the metastable region adjacent to the liquid-vapor critical point. The choice of liquid xenon as the object of investigation is connected with its increased radiation resistance, which made it possible to measure thermodynamic properties with a deep penetration into the metastable region.

An alternating-current piezometer was used to measure the density. Experiments were made on 20 isotherms in the temperature range from 265 to 290 K and the density range from 450 to 2150 kg/m$^3$. No peculiarities were discovered in the behavior of the first (density) and the second (compressibility) derivatives of the thermodynamic potential in passing through the line of equilibrium phase coexistence $p_s(T)$. The maximum depth of penetration into the metastable region by pressure was $\Delta p = p_s(T) - p = 0.65$ ~MPa on the isotherm T = 270.01 K.

The isochoric heat capacity of xenon was measured in soldered glass ampoules fixed in the measuring chamber of a scanning calorimeter. Experiments were made on 5 isochores in the regime of continuous cooling in the density range from 1200 to 1500 kg/m$^3$. The maximum value of supercooling of the liquid phase was $\Delta T = T_s - T = 0.4$ K at $\rho = 1482$ kg/m$^3$. The values of $\Delta T$ are in good agreement with their values given by the homogeneous nucleation theory.

A crossover equation of state has been built up to describe thermodynamic properties of stable and metastable xenon in a wide vicinity of the critical point. It conveys the scaling laws in the asymptotic vicinity of the critical point and turns into a cubic equation of the Van-der-Waals type far from the critical point. The equation of state within the limits of experimental error describes both the first (p, ρ, T properties) and the second ($c_v$) derivatives of the thermodynamic potential. The spinodal of superheated liquid xenon has been determined in the framework of the crossover equation of state. The behavior of thermodynamic properties on the spinodal and their asymptotics in the critical and the spinodal regions are discussed.